Minimum Flows and Levels for Lake Okeechobee, the Everglades, and the Biscayne Aquifer

Executive Summary

Chapter 1.- Introduction

This report documents the methods and technical criteria used by staff of the South Florida Water Management District (SFWMD) to develop proposed Minimum Flows and Levels (MFLs) for Lake Okeechobee, the Everglades, and the Biscayne aquifer. Section 373.042 (1), F.S., defines MFLs and directs the SFWMD to use the best available information in establishing a minimum flow or level. Passage of additional MFL legislation in 1997 added the requirements to consider changes and structural alterations, allow exclusions, and require development of a recovery strategy for water bodies that are not expected to meet the proposed criteria.

Water Resource Functions. Each surface water body or aquifer serves an array of functions. Water resource functions protected under Chapter 373 are broad and include flood control, water quality protection, water supply and storage, fish and wildlife protection, navigation, and recreation.

Harm Standards. Surface water management and consumptive use permitting regulatory programs must prevent **harm** to the water resource. The hydrological criteria include level, duration, and frequency components and are used to define the amount of water that can be allocated from the resource. For purposes of establishing MFLs, **significant harm** is defined as loss of water resource functions that take multiple years to recover, which result from a change in surface water or ground water hydrology. Water shortage declarations are designed to prevent **serious harm,** interpreted as long-term, irreversible, or permanent impacts, from occurring to water resources.

Chapter 2 - Description of Water Bodies

The hydrology of South Florida is strongly affected by its climate, rainfall and seasonal weather patterns. The region has a subtropical climate and average annual rainfall of 53 inches. About 75% of this rainfall occurs during the hot and humid wet season (May through October) and the remainder during the mild dry season (November through April). Construction of the Central and Southern Florida Project for Flood Control and other Purposes (C & SF Project), has significantly altered hydrology, especially from Lake Okeechobee to Florida Bay along Florida's Southeast Coast.

Lake Okeechobee. Lake Okeechobee is a large, shallow, eutrophic lake located in south central Florida that serves as a multipurpose reservoir to meet regional water management needs. Development of a minimum level for Lake Okeechobee is based on achieving balanced protection of four water resource functions: a) maintaining levels in coastal canals; b) meeting water storage and supply needs; c) providing fish and wildlife habitat; and d) supporting navigation and recreational use. Lake Okeechobee water depths are controlled by a regulation schedule, while allocations of water from the lake during drought periods are based on a drought management plan.

Everglades. The Everglades is an internationally recognized ecosystem and is the largest subtropical wetland in the United States. Today's Everglades is comprised of five Water Conservation Areas (WCAs), the Holeyland and Rotenberger Wildlife Management Areas (WMAs) and Everglades National Park. Minimum level criteria and definition of significant harm for the Everglades were based on protecting six water resource functions: a) providing recharge to protect the Biscayne aquifer; b) supporting Everglades ecosystems c) providing natural biological filtering and nutrient cycling; d) providing refugia for aquatic wildlife e) preventing invasion by undesirable species; and f) maintaining desired salinities in coastal estuaries. Everglades water levels are managed based on regulation schedules in the WCAs and a rainfall based water delivery plan for Everglades National Park

Biscayne Aquifer. The Biscayne aquifer provides most of the fresh water for public water supply and agriculture in southeast Florida. Three water resource functions were considered, to provide a primary source of water supply, supply base flow to coastal estuaries, and prevent saltwater intrusion. The principal issue regarding development of minimum level criteria for the Biscayne aquifer is saltwater intrusion. Although the relationships between water levels in coastal canals and chloride levels in the

monitoring wells have not been defined, sustained low water levels in canals are an indicator that problems may occur in the future.

Considerations and Exclusions. During development of MFL criteria for Lake Okeechobee, the Everglades, and the Biscayne aquifer, a number of structural changes or alterations were considered, along with the constraints such changes have placed on the hydrology of the region. District staff recommend that exclusions, as defined in Chapter 373 F.S., should not be applied to establish MFLs for Lake Okeechobee, the Everglades, and the Biscayne aquifer.

Chapter 3 - Methods

Lake Okeechobee. Minimum water level criteria for Lake Okeechobee were based on review of drought management plans, historical data, and ecological research Drought management plans indicated that the amount of rainfall that falls in South Florida from year-to-year is highly variable. Historical data showed that when lake levels fall below 11 ft, water levels declined rapidly, affecting the lake's ecology and the ability to deliver water downstream. As water levels fell below 10.5 ft, limitations of outlet structures made it difficult to provide water to protect coastal wellfields against saltwater intrusion. Review of ecological research showed that a decline in lake levels from 12 to 11 ft has significant impact, including a 20% loss of aquatic habitat. These impacts became worse as water levels declined below 11 ft. Relatively little ecological information exists to determine a minimum duration and return frequency, so these components were estimated based on analysis of historical records from 1952 to 1995. Significant harm to navigation and recreation was determined based on water depths needed for safe navigation of the Okeechobee Waterway, bathymetry maps, and discussions with marina operators and boat captains.

Everglades. Minimum water level criteria for the Everglades were based on results of a literature review, historical water level and fire data, and data from a mathematical model. Information from the literature described the ranges of water levels that occurred during droughts in the Everglades and other peat and marl based wetlands. Historical water levels were compared with available fire records from the Florida Fish and Wildlife Conservation Commission and published literature. The Natural Systems Model was used as a supplemental means to estimate minimum water depth, duration and return frequency under natural conditions during low rainfall years.

Biscayne Aquifer. Literature was compiled and summarized concerning the hydrology and hydrogeology of southeast Florida, the Biscayne aquifer, and saltwater intrusion in unconfined aquifers. Four sources of information were analyzed as follows: water quality and water level data, influence of canals on coastal aquifer water levels using a regional model, influence of canals on location of the saline interface using a two-dimensional solute transport/flow model, and comparison of these data to estimates derived from a theoretical relationship between surface and ground water levels.

Chapter 4 - Proposed Criteria

MFL technical criteria for Lake Okeechobee, the Everglades, and the Biscayne aquifer were defined based on the functions provided by the resource and a number of technical relationships.

Lake Okeechobee. The significant harm criteria for Lake Okeechobee were based on the relationship between water levels in the lake and the ability to: a) protect the coastal aquifer, b) Supply water to Everglades National Park, c) provide littoral zone habitat for fish and wildlife, and d) ensure navigational and recreational access. In addition, consideration was given to supplying water to adjacent areas such as the Everglades Agricultural Area, the Seminole Indian Tribe, and the Caloosahatchee and St. Lucie basins. Proposed minimum water level criteria for Lake Okeechobee include two components:

Operational MFL Criteria - *During most years, water levels in Lake Okeechobee should not fall below 11 ft NGVD. However, in order to make water deliveries from the lake to the LEC Planning Area, the water level in the lake may occasionally fall below 11 ft NGVD from April 15 to July 15, as long as it does not drop below the top of Supply-Side Management Zone C.*

Water Supply Planning MFL Criteria - *The water level in the lake should not fall below 11 ft NGVD for more than 80 days duration, more often than once every six years, on average.*

Everglades. Technical relationships for the Everglades included analysis of the effects of water levels on hydric soils, plant and wildlife communities, and frequency and severity of fires. Everglades “no harm”

standards will be derived from model simulations for the year 2020 that include implementation of the Comprehensive Everglades Restoration Plan. Impacts associated with significant harm include increased peat oxidation, frequency of severe fires, soil subsidence, loss of aquatic refugia, loss of tree islands; and long-term changes in vegetation or wildlife. The proposed minimum water level criteria for the Everglades considered the two dominant soil types as follows:

*Water levels within wetlands overlying **organic peat soils** within the WCAs, Rotenberger and Holey Land WMAs, and Shark River Slough (Everglades National Park) should not fall 1.0 feet or more below ground level for more than 30 days, at specific return frequencies for different areas, as identified in the report.*

*Water levels within **marl-forming wetlands** that are located east and west of Shark River Slough, the Rocky Glades, and Taylor Slough within Everglades National Park should not fall more than 1.5 feet below ground level for more than 90 days, no more frequently than once every 5 years.*

Biscayne Aquifer. Technical relationships considered for the Biscayne aquifer included analysis of relationships among ground water levels, canal water levels and saltwater intrusion. Harm occurs when the saltwater interface moves further inland than has occurred historically due to seasonal water level fluctuations, up to and including a 1-in-10 year drought. Significant harm occurs when saline ground water moves inland to an extent that it limits the ability of users to obtain fresh ground water in the amounts specified in their permits and will require several years for the freshwater source to recover. The proposed criteria consist of a minimum canal operational level and duration of the event:

Minimum Canal Operational Level - *The minimum water level in a canal, which, if managed for a specific period of time, is sufficient to restrict saltwater intrusion within the coastal aquifer and prevent significant harm from occurring during a period of deficient rainfall.*

Duration - *The estimated period of time that canal water levels may remain below the minimum level without causing significant harm to coastal ground water resources.*

Minimum Water Level -*Water levels in the Biscayne aquifer associated with movement of the saltwater interface landward to the extent that ground water quality at the withdrawal point is insufficient to serve as a water supply source for a period of several years before recovering.*

Chapter 5- Conclusions and Recommendations

Research is needed to address technical issues and relationships noted above. Proposed programs for Lake Okeechobee include: development of an updated vegetation map, and field monitoring and experiments to determine factors that influence expansion of torpedo grasses. Research for the Everglades includes studies of: peat accretion in WCA-2A and Everglades National Park, tree islands in WCA-3A and WCA-3B, nutrient thresholds in Everglades ecosystems, vegetation distribution, plant and animal communities in marl-forming wetlands, spatial distribution of soils, wading bird nesting and foraging, distribution and abundance of apple snails, movement and abundance of wading birds, and methods to improve regional models. Additional research is needed in Florida Bay to study sediment cores, the salinity transition zone, seagrass and plankton models and fish communities. Research for the Biscayne aquifer includes development of a solute transport ground water model, improved saltwater intrusion monitoring, and studies of relationships between canal stages and saltwater intrusion, minimum canal level duration, causes of depressed canal and aquifer levels, and potential remedies.